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Review

Review of decontamination protocols for shared non-critical objects in 35 policies of UK NHS acute care organizations

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SUMMARY

Background: Decontamination of non-critical objects shared by patients is key in reducing hospital-acquired infections (HAIs), but it is a complex process that needs precise guidance from UK National Health Service (NHS) acute care organizations (ACOs).
Aim: To review the indications given by NHS ACOs' policies regarding the decontamination of shared non-critical devices.
Methods: Detailed lists of decontamination protocols for shared non-critical objects were retrieved from cleaning, disinfection and decontamination policies of 35 NHS ACOs. Three parameters were considered for each object: decontamination method, decontamination frequency, and person responsible for decontamination.
Findings: In total, 1279 decontamination protocols regarding 283 different shared non-critical objects were retrieved. Of these, 689 (54%) did not indicate the person responsible for decontamination, and only 425 (33%) were complete, giving indications for all three parameters analysed. Only 2.5% (32/1279) of decontamination protocols were complete and identical in two policies. In policies where cleaning represented the major decontamination method, chemical disinfection was rarely mentioned and vice versa. General agreement among policies was found for four main decontamination methods (detergent and water, detergent wipes, disinfectant wipes, and use of disposable items), two decontamination frequencies (between events and daily) and two responsible person designations (nurses and domestic staff).
Conclusions: Decontamination protocol policies for shared non-critical objects had some similarities but did not concur on how each individual object should be decontaminated. The lack of clear indications regarding the person responsible for the decontamination process put at risk the ability of policies to serve as guidance.

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Introduction

Healthcare-acquired infections (HAIs) affect approximately 6 million patients every year in Europe and the USA combined, causing >100,000 deaths, contributing to decreased quality of life and increased hospitalization duration and costs [1–3]. Given the ability of pathogens to survive on dry surfaces [4–6], their ability to form biofilms [7,8], and the direct correlation between HAIs and environmental bioburden [9], adequate decontamination of the healthcare environment is fundamental in protecting patients and staff [10–13]. Objects shared between patients and between healthcare workers pose a particular risk, as they can readily transmit pathogens to multiple individuals [14]. Although often overlooked [15,16], shared medical devices [17–23] – such as thermometers [24,25] and blood pressure (BP) cuffs [26,27] – and non-medical items – such as privacy curtains [28,29] and clipboards [30] – can harbour potentially dangerous pathogens. BP cuffs, for example, have been identified as fomites in different HAI outbreaks [14,31,32] and, recently, a *Candida auris* outbreak in an English neuroscience intensive care unit was attributed to shared axillary thermometers [33].

Depending on the level of bioburden reduction required, adequate decontamination can be achieved by means of washing with detergent or/and chemical disinfectants, as well as with automated or semi-automated disinfection devices exploiting heat, ultraviolet light or hydrogen peroxide vapour [34–36]. Each method is effective in reducing bioburden, but has clear limitations [34]. For example, the operators' accuracy affects the efficacy of manual decontamination [37], whereas the compatibility of chemical, thermal and radiative decontamination with devices must be taken into account to avoid damage [38]. Moreover, decontamination methods do not prevent recontamination, which can occur within a few hours [39,40].

Assessing how and when a specific object should be decontaminated is thus not an easy task, and should not be left to the discretion of untrained operators but should be codified in clear policies [13,41] A robust regimen of best practice, training, feedback and auditing positively impacts the outcome of the process [42–45].

The authors analysed current protocols for the decontamination of shared non-critical [46] objects (SNCOs) from 35 National Health Service (NHS) acute care organizations (ACOs) in the UK, focusing on three necessary indications that should be provided by the policies: the decontamination method (how), the decontamination frequency (when), and the person responsible for performing the decontamination (who). The aim of this review was to understand how precise and complete the decontamination protocols reported in policies are, highlighting both common trends and inconsistencies among ACOs.

Methods

Definitions and terminology

The following definitions were retrieved from the policies:

- Cleaning: a process that physically removes dirt, contamination and many micro-organisms using microfibre cloths, neutral detergent, water or equivalent.
- Disinfection: a process to reduce the number of micro-organisms to a less harmful level. This process does not necessarily destroy bacterial endospores.
- Sterilization: total removal or destruction of all micro-organisms, including bacterial spores.
- Decontamination: a general process that removes, or renders harmless, harmful substances such as noxious chemicals, harmful bacteria or other organisms.

Decontamination includes cleaning, disinfection and sterilization. The following terminology was used:

- Indication: any decontamination method, person responsible or decontamination frequency indicated by the policies for the decontamination of a single object.
- Decontamination protocol: the ensemble of indications regarding decontamination method, frequency and person responsible given by a specific policy for a specific object.
- Complete protocol: any protocol where indications are given for all three parameters.
- Complete and unequivocal protocol: any complete protocol presenting a single indication for the method, a single person responsible and a specific frequency.

Inclusion and exclusion criteria

Cleaning, decontamination and disinfection policies and procedures were obtained by the authors from 35 UK NHS ACOs (Table S1, see online supplementary material) either from their websites (searching in the policies repository for any document regarding 'decontamination', 'cleaning' and 'disinfection') or (when the repository was not accessible, was incomplete or was out of date) via direct request following the Freedom of Information Act. Any policy and procedure regarding 'decontamination', 'cleaning' and 'disinfection' was investigated. In addition, policies mentioning specific standard operating procedures were investigated. Thirty-five ACOs were selected in two steps. First, five ACOs were selected, as their policies were available online. The information from these ACOs was used to develop the database used throughout this review. The other 30 ACOs were selected to provide comprehensive coverage of the UK. The number was limited to 35 ACOs to allow for timely review of the policies. Among the policies obtained, documents concerning the reprocessing of endoscopes alone were not considered. Retained documents were read by the authors, searching for detailed lists of protocols for the decontamination of specific objects (A–Z lists). The lists and the associated decontamination protocols were then analysed as reported below.

The objects mentioned in the policies were categorized as follows:

- The Spaulding classification [46,47] for medical devices was extended and used to categorize the objects into 'critical', 'semi-critical' or 'non-critical' which relates to object contact with sterile parts of the body, mucous membranes/non-intact skin or intact skin. Therefore, in this instance, 'environmental surfaces' as defined by the US Centers for Disease Control and Prevention [48,49] were classified as 'non-critical' objects as they are expected to contact the intact skin of patients.
- According to their consecutive use on different patients, objects were categorized as 'shared' and 'non-shared'.
- According to their consecutive use in different rooms/environments, objects were categorized as 'fixed' or 'movable'.

Critical and semi-critical devices were not considered in this work as they have been widely discussed in the literature [38,50–52].

Analysing multiple entries

A full list of the objects retained, and their categorization, is reported in Table S2 (see online supplementary material). For each object, the 'standard' decontamination procedure was analysed, and the following three parameters were extracted: decontamination method, decontamination frequency, and person responsible for decontamination. The authors did not consider where the decontamination should take place because, in general, no specific indication was given. Presumably, policy makers assume that objects should be decontaminated where they are used. Exceptions were bodily fluids containers (which have dedicated decontamination rooms/sluices), objects subjected to sterilization (brought to the sterilization units) and objects subjected to laundry. For simplicity, the different decontamination methods, frequencies and professionals responsible were grouped in consistent ensembles (Tables S3–S5, see online supplementary material). Methods were grouped according to how the environmental bioburden is reduced: cleaning, chemical/thermal/high level disinfection, sterilization, use of disposable items, or following manufacturer instructions. To note, all of the disinfection methods included a first cleaning step to remove soiling before disinfection. Frequencies were grouped into wider time periods: between caring events, once or more per day, every 4–14 days, monthly or less often, and when required. The professional figures responsible were categorized according to their main role other than decontamination: first-/second-line health care, estates (including domestic and housekeeping personnel), administrators, non-specific, and other.

Where an object was subjected to more than one procedure (e.g. daily dump dust and weekly disinfection), the procedure with the higher frequency was considered as the outcome would affect more patients and staff. Where, for the same objects, enhanced procedures were listed together wih standard procedures, only the latter were considered. Finally, when different protocols were reported for the same object in different settings, the procedure for a general ward was selected.

Evaluations of cleaning or chemical disinfection prevalence

Two analyses were undertaken to evaluate if the decision to clean or chemically disinfect an SNCO was object-dependent or ACO-dependent:

- SNCOs were divided into three groups – those with indications for cleaning alone, those with indications for chemical disinfection alone, and those with both.
- For each ACO, the following ratios were calculated:

$$C_r = \frac{\textit{indications for cleaning}}{\textit{indications for cleaning} + \textit{indications for chemical disinfection}} \quad (1)$$

$$D_r = \frac{\textit{indications for chemical disinfection}}{\textit{indications for cleaning} + \textit{indications for chemical disinfection}} \quad (2)$$

The ACOs were divided into two groups – those where the indications for cleaning were more than those for chemical disinfection (C_r>50%), and those where the opposite was true (D_r>50%). The average ratios $\overline{C_r}$ and $\overline{D_r}$ were calculated for each group.

Results

At-a-glance protocol recap

Policies from 35 ACOs were obtained, containing, in total, 1712 decontamination protocols for 416 different objects. Of these objects, 283 were SNCOs with a total of 1279 decontamination protocols.

Policy overview

Seventy-one percent of the policies obtained (25/35) reported a clear definition of 'decontamination', 'cleaning', 'disinfection' and 'sterilization', coherent with those reported in the Methods section (Figure S1a,b, see online supplementary material). One policy omitted the definition of 'decontamination' and another policy omitted the definition of 'sterilization'. The remaining eight policies (23%) did not report any of these definitions. The definitions were consistent among the 27 policies that reported them.

Forty percent of the policies obtained (14/35) reported at least one method to assess the effectiveness of decontamination procedures (Figure S1c, see online supplementary material): three mentioned adenosine triphosphate (ATP) assay following surface swabbing, and all 14 mentioned a visual check. Fifty-one percent of the policies (18/35) reported at least one method to record the occurrence of the decontamination event: 11 mentioned labelling, nine mentioned the use of a written record and four mentioned a barcode tracking system.

Further details about the origin and expiry date of the policies can be found in the online supplementary material (Supporting Section 1 and Figure S2).

A–Z decontamination protocol lists

Seventy-one percent of the policies analysed (25/35) included extensive A–Z object decontamination protocol lists, mentioning a total of 416 different objects (average 69 per policy, range 18–118 – Figure S2c, see online supplementary material). On average, each object was cited by four policies (range 1–22, median 2), but no policies mentioned more than 28% (118/416) of the total number of objects analysed (Figure S2d, see online supplementary material). Thirteen percent of the objects (54/416) appeared in 10 or more policies (Table S6, see online supplementary material).

Shared non-critical objects

Decontamination protocols

Sixty-eight percent (283/416) of the objects retrieved were SNCOs. Seventy-five percent (1279/1712) of all the

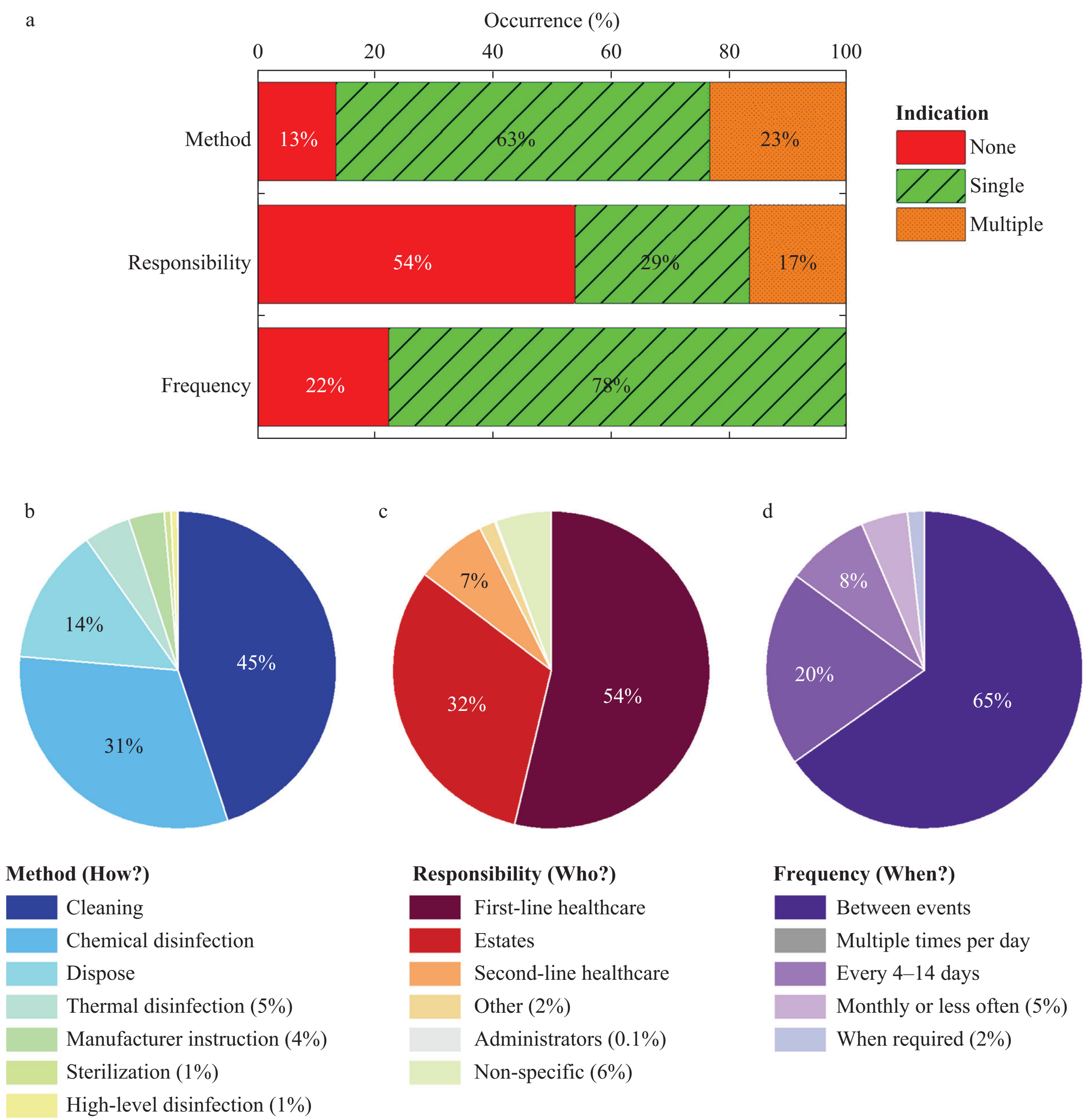

Figure 1. Decontamination protocols for shared non-critical objects. (a) Prevalence of protocols with no, single or multiple indications regarding decontamination method, frequency and person responsible for shared non-critical objects. Summarized indications retrieved for the decontamination method (b), responsibility (c) and frequency (d). In (b), (c) and (d), the graphs are normalized for the total number of indications given, excluding the entries where no indication was present. Further details can be found in Figure S3 (see online supplementary material).

protocols retrieved concerned SNCOs. Of these protocols, 87% (1107/1279) indicated decontamination method, 78% (993/1279) indicated decontamination frequency and only 46% (590/1279) indicated the person responsible for decontamination (Figure 1a). Thirty-three percent of the protocols (425/1279) were found to be complete and 15% (192/1279) were complete and unequivocal. Figure 1b,c,d and Figure S3a,b,c (see online supplementary material) detail the indications given for decontamination methods, responsibility and frequency. Examples of decontamination protocols of common SNCOs are reported in Supporting Section 2, Figures S4 and S5, and Tables S7 and S8 (see online supplementary material).

Overall, 2% of the protocols (32/1279) concerning 6% of the SNCOs (16/283) were complete and identical in two policies (Table S9, see online supplementary material). Common protocols were not shared by more than two ACOs. All but three of these protocols were complete and unequivocal.

Effect of fixed spatial position

Fifty percent of SNCOs (143/283) were categorized as 'fixed' in the environment, and 50% (140/283) were categorized as 'movable'. Figure 2 summarizes how this affected the decontamination protocols.

Cleaning vs chemical disinfection

One hundred and two SNCOs had indications for both cleaning and chemical disinfection, whilst 65 had indication for cleaning but not chemical disinfection, and 60 had indications for chemical disinfection but not cleaning. In 12 ACOs, there were more indications for cleaning than for chemical disinfection (C_r>50%), and $\overline{C_r} : \overline{D_r} = 85 : 15$ (i.e. on average, there were 5.7 cleaning indications per chemical disinfection indication. In the other 11 ACOs, the situation was reversed, with more indications for chemical disinfection than for cleaning ($D_r > 50\%$), and $\overline{C_r} : \overline{D_r} = 22 : 78$ (i.e. one cleaning indication for every 3.5 chemical disinfection indications).

Discussion

The analysis of decontamination protocols for 416 objects demonstrated the complexities involved in performing complete and effective decontamination of the healthcare environment. It is unrealistic for any healthcare worker to know how each of these objects should be decontaminated and who is responsible for it, unless methods, frequencies and designation of responsibilities are clearly defined and communicated. As recently detailed in a survey carried out in Australia, nurses and midwives, for example, are perfectly aware of the importance of decontamination, but are often confused regarding the best way to perform it or who is responsible for it [53]. On the other hand, as reported by Shepherd *et al.* [54], when a process of rationalization of decontamination procedures and extensive training is carried out, not only are most of these doubts resolved, but the decontamination itself becomes faster and more effective. Therefore, a rational, accessible list of objects with the associated decontamination protocols can help to reduce the risk of suboptimal decontamination. The protocols, if complete and unequivocal, can resolve any doubt or misunderstanding regarding how an object should be decontaminated, how often and by whom. However, 29% (10/35) of the policies analysed did not provide a detailed list. Those policies with a protocol list mentioned, on average, 16% of the total range of objects retrieved. None mentioned more than 28% of the total number of objects analysed (Figure S2c, see online supplementary material). This means that each policy maker had a different concept regarding which objects

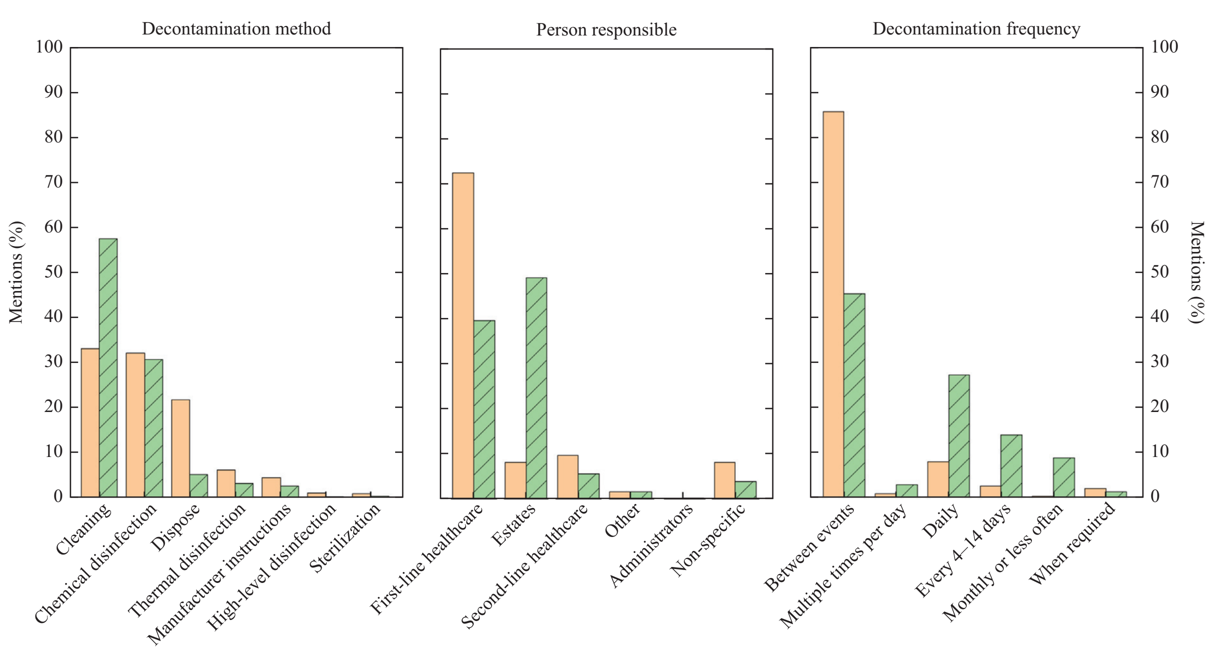

Figure 2. Effect of spatial mobility on decontamination protocols of shared non-critical objects (SNCOs). Indications for decontamination method, frequency and person responsible associated with SNCOs with fixed (green) or movable (orange) spatial position are grouped in extended category (see Methods and Tables S3–S5, see online supplementary material). In each graph, the sum of all the indications referred to each single group (fixed or movable) is set to 100%.

should be singled out in the decontamination protocol lists. As a result, each policy did not give any guidance for >70% of the objects that some other British policy deemed important. The presence of local guidelines (upon which single ACO's policies are based) with detailed decontamination protocols, such as those implemented in Scotland and Northern Ireland, helps to offset this inhomogeneity. However, to fully serve the scope, these guidelines should cover more objects than those listed at present (36 for Scotland, 80 for Northern Ireland).

Another important consideration that came from this review is the lack of tools for assessing the efficacy of decontamination. Only three policies employed a quantitative method (ATP swabbing) to identify residual bioburden, while most of the policies relied on visual inspection or a tracking system that registers the decontamination event but not its efficacy. Curiously, none of the policies mentioned the use of ultraviolet fluorescent markers, although they have been employed effectively to improve the decontamination standards of various healthcare organizations [4,12,34,45,55].

The lack of precise decontamination protocols might be particularly detrimental for SNCOs. Given their non-critical nature, they can be overlooked during decontamination if not indicated properly in the policy because of time constraints or lack of awareness [4,26,56]. Nonetheless, their ubiquity (68% of the objects mentioned in the policies) and their use on/by multiple patients makes them dangerous fomites for infections [14,33]. The minimum information expected in the decontamination protocols associated with each object includes the decontamination method, frequency and person responsible. This latter indication was absent in 55% of the protocols regarding SNCOs (Figure 1a), even for the most common objects such as thermometers and stethoscopes (Figure S4c, see online supplementary material). Indeed, only 33% of the total protocols were complete, severely reducing their value. Another problem was the lack of univocity (only 15% of the total protocols were complete and unequivocal). Having multiple indications for the decontamination method or person responsible can create confusion, reducing the overall decontamination efficacy.

Another interesting aspect noted during the analysis was a lack of homogeneity among the policies of different ACOs. Even in the presence of national guidance, each ACO had a different protocol for the decontamination of the same object. For example, commodes (mentioned in 21 policies) were routinely cleaned in four ACOs, chemically disinfected in 10 ACOs, and treated with high-level (sporicidal) disinfectants in three ACOs (Figure S5, see online supplementary material). The decontamination frequency of BP cuffs spanned from 'between uses' to 'weekly' and 'when required'. Only 16 objects had complete protocols shared by two policies. These observed inhomogeneities should not represent a major issue in term of decontamination efficacy, as long as the scientific bases behind each decision are solid. Indeed, one needs to take into account that each ACO operates in unique conditions and faces different challenges. However, a real conceptual clash was observed when choosing between cleaning and chemical disinfection. More than 30% of all the SNCOs (102/283) had indications for both cleaning and disinfection, and half of the ACOs leant strongly towards cleaning whereas the other half strongly recommended chemical disinfection. This suggests that cleaning and disinfection were seen by the people who formulated the policies as mutually exclusive decontamination methods. The choice of one of them was not dictated by the nature of a single SNCO (and the risks it poses), but by an ACO's philosophical preference for one or the other method. The reason why different ACOs made different decisions is probably related to the ongoing debate about when cleaning should be favoured over chemical disinfection [4,13].

The policies analysed had several traits in common, which might be useful for elaborating a comprehensive set of guidelines to prevent the formulation of incomplete and/or misleading decontamination protocols and policies. Firstly, the policies agreed on the definitions of decontamination, cleaning, disinfection and sterilization, and on the importance of including them, creating a common ground, and avoiding misinterpretation. There was a general consensus about the principal decontamination methods that should be employed on SNCOs, as four of them (detergent and water, detergent wipes, disinfectant wipes, and the use of disposable items) covered approximately 85% of the indications (Figure S3a, see online supplementary material). When the person responsible for decontamination of SNCOs was listed, this responsibility was usually split between first-line healthcare professionals (54% of the indications) and estates workers (32%), with nurses (38%) and domestic staff (29%) sharing the highest burden (Figure S3b, see online supplementary material).

In general, the policies agreed that the decontamination of SNCOs should be carried out either between caring events or at least daily, as these indications made up 85% of all indications. It is interesting to notice, however, how the spatial position affected the recommended decontamination frequency (Figure 2): for movable objects, decontamination was indicated between caring events (86%), whereas fixed objects had a broader range (between events 45%, daily 27%, every 4–14 days 14%). According to the policies, objects that change location should be cleaned more often, probably because they are perceived as more prone to recontamination. However, a recent quantitative analysis in a New York City hospital clearly highlights how fixed objects are actually touched more often, particularly bed rails, privacy curtains and visitor chair armrests [57]. These objects, in the policies analysed (Figure S6, see online supplementary material), were not among those decontaminated most often, as they were usually decontaminated daily (bed rails, chairs) or far less often (curtains).

Limitations of the study

This study analysed only 35 organizations that supplied the policies. However, these organizations encompassed the entire UK, and included areas where there was national guidance. No attempt was made to determine whether the policies were implemented as planned, whether any audits to determine effectiveness were undertaken, nor the scientific evidence or legal groundwork on which the policies based their indications; this review merely reports their content.

Conclusions

In conclusion, providing patients with a clean and safe environment is key to reducing HAIs and the associated deaths and costs. However, environmental decontamination is a challenging process: removing soiling (which spans from viruses to dust, from biofilms to spores) without damaging the target object requires either extensive knowledge or precise guidance. The decontamination protocols obtained from the decontamination policies of UK NHS ACOs were inconsistent. Focusing on the decontamination indications reported for SNCOs, substantial agreement was identified among policies regarding prevalent decontamination methods, frequencies and the person responsible, but how these parameters were combined and assigned to different objects was far from univocal. Similarly, the lack of scientific agreement around the cleaning or disinfection contrast is reflected in the policies, with ACOs strongly leaning either towards one or the other. Two points were most alarming:

- the lack, in each policy, of specific decontamination protocols for most of the SNCOs mentioned by other policies; and
- the consistent lack of designated responsibility for decontamination.

Overall, the policies analysed would greatly benefit from a wider consensus amongst policy makers, and extended consultation with those who have to implement them. This would ensure greater completeness, improve communication and remove the potential for confusion, ultimately enhancing patient safety.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jhin.2021.10.021.

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